CLAIMS

1. A fuel-transfer system for a fuel system of a vehicle including a filler neck and a fuel tank including a top wall and a bottom wall spaced apart from the top wall, the fuel-transfer system comprising

a valve carrier formed to include a valve seat and a fuel-transfer channel terminating at the valve seat and adapted to be coupled to a filler neck and a fuel tank to conduct fuel from the filler neck to the fuel tank through the fuel-transfer channel and

a tank inlet check valve apparatus mounted on the valve carrier for pivotable movement about a pivot axis between a closed position engaging the valve seat to block discharge of fuel from the fuel-transfer channel and an opened position disengaging the valve seat to allow discharge of fuel from the fuel-transfer channel, the tank inlet check valve apparatus including a valve mover pivotably coupled to the valve carrier at the pivot axis, a diverter valve including a closure coupled to the valve mover for movement therewith and a seal ring coupled to the closure to move therewith relative to the valve seat, and a biasing spring arranged to yieldably pivot the valve mover about the pivot axis to move the closure normally toward the valve seat to trap the seal ring between the closure and the valve seat to locate the tank inlet check valve apparatus in the closed position.

2. The fuel-transfer system of claim 1, wherein the closure includes a mover mount coupled to the valve mover, a seal mount coupled to a peripheral portion of the mover mount and coupled to the seal ring, and a siphon tube deflector coupled to the mover mount and arranged to extend into the fuel-transfer channel upon movement of the seal ring to engage the valve seat and adapted to intercept and guide a siphon tube moving through the filler neck into the fuel-transfer channel toward a bottom wall of the fuel tank.

3. The fuel-transfer system of claim 2, wherein the seal ring includes an annular inner edge and the siphon tube deflector is cantilevered to the mover mount to project through an aperture defined by the annular inner edge.

4. The fuel-transfer system of claim 2, wherein the siphon tube deflector includes a ridge adapted to engage a siphon tube extending through the filler neck to reach the bottom wall of the fuel tank upon movement of the tank inlet check valve apparatus to the opened position to retain the tank inlet check valve apparatus in the opened position and an inclined surface arranged to extend between the mover mount and the ridge and intercept a siphon tube passing through the fuel-transfer channel and into the fuel tank to move the valve mover against the biasing spring to cause the tank inlet check valve apparatus to move to the opened position.

5. The fuel-transfer system of claim 4, wherein the valve carrier includes a pipe having an interior wall defining a boundary of the fuel-transfer channel and a plurality of siphon tube guides coupled to the interior wall to lie in the fuel-transfer channel and arranged cooperatively to define means for guiding a tip of a siphon tube moving in the fuel-transfer channel in a direction toward the tank inlet check valve apparatus to intercept in sequence the inclined surface and the ridge of the siphon tube deflector to cause the tank inlet check valve apparatus to move to the opened position in response to continued movement of the tip of the siphon tube toward the bottom wall of the fuel tank.

6. The fuel-transfer system of claim 2, wherein the valve carrier includes a pipe having an interior wall defining a boundary of the fuel-transfer channel and a plurality of siphon tube guides coupled to the interior wall and arranged to lie in spaced-apart relation to one another and extend toward a longitudinally extending central axis of the pipe to define therebetween a reduced-diameter passageway in the fuel-transfer channel sized to receive a siphon tube moving in the fuel-transfer channel toward the tank inlet check valve apparatus and guide that siphon tube to engage the siphon tube deflector coupled to the mover mount.

7. The fuel-transfer system of claim 6, wherein the interior wall of the pipe has a cylindrical shape and the plurality of siphon tube guides are circumferentially spaced apart from one another about the interior wall.

8. The fuel-transfer system of claim 6, wherein each of the siphon tube guides is fin-shaped and cantilevered to the interior wall of the pipe.

9. The fuel-transfer system of claim 6, wherein each of the siphon tube guides includes a slide edge arranged to lie in substantially parallel relation to a

longitudinally extending central axis of the pipe and in close proximity to the valve seat and a sloping ramp edge having a leading edge merging with the interior wall of the pipe and a trailing edge merging with the slide edge to cause the sloping ramp edges of the siphon tube guides to converge toward the longitudinally extending central axis of the pipe in a direction toward the valve seat.

10. The fuel-transfer system of claim 1, wherein the valve carrier includes a valve housing including a pipe formed to include the valve seat and the fuel-transfer channel and a sleeve surrounding a portion of the pipe formed to include the valve seat and the valve mover is pivotably coupled to the sleeve and arranged to lie outside of the fuel-transfer channel.

11. The fuel-transfer system of claim 10, wherein the valve mover includes first and second pivot pins extending in opposite directions from one another to extend respectively into first and second pin receivers formed in the sleeve and the sleeve is formed to include a first pin guide slot terminating at the first pin receiver and a second pin guide slot terminating at the second pin receiver.

12. The fuel-transfer system of claim 10, wherein the valve carrier further includes a housing jacket overmolded onto the valve housing and adapted to be coupled to a filler neck and a fuel tank and the valve housing further includes a radially outwardly extending annular pipe anchor coupled to an exterior surface of the pipe and arranged to mate with the housing jacket and the sleeve includes a proximal end coupled to the radially outwardly extending annular pipe anchor.

13. The fuel-transfer system of claim 1, wherein the valve mover includes a base pivoter coupled for pivotable movement to the valve carrier at the pivot axis and a base coupled to the base pivoter to pivot therewith and formed to include a post receiver and the closure includes a mounting post formed to include a central axis extending longitudinally therethrough and arranged to extend through the post receiver formed in the base to retain the closure in coupled relation to the base yet allow limited movement of the closure relative to the base owing to movement of the central axis of the mounting post relative to the pivot axis during seating on the valve seat of the seal ring carried on the closure during movement of the tank inlet check valve apparatus to assume the closed position.

14. The fuel-transfer system of claim 13, wherein the base pivoter includes first and second pivot arms cantilevered to the base, a first pivot pin coupled to the first pivot arm and arranged to extend into a first pin receiver formed in the valve carrier to intersect the pivot axis, and a second pivot pin coupled to the second pivot arm and arranged to extend into a second pin receiver formed in the valve carrier to intersect the pivot axis.

15. The fuel-transfer system of claim 13, wherein the post receiver has an inner diameter and the mounting post includes a post shaft that extends through the post receiver and has an outer diameter that is less than the inner diameter of the post receiver so as to allow rotary motion of the diverter valve relative to the valve mover in every direction within predetermined limits and a post retainer that is coupled to a distal end of the post shaft and has an outer diameter that is larger than the inner diameter of the post receiver normally to block removal of the post shaft from the post receiver formed in the base of the valve mover.

16. The fuel-transfer system of claim 15, wherein the base is formed to include at least one slit extending radially outwardly from the post receiver to form at least two deformable sections in the base that deform temporarily during movement of the post retainer through the post receiver to locate the post shaft in the post receiver to couple the diverter valve to the valve mover.

17. The fuel-transfer system of claim 13, wherein the valve mover further includes at least one socket pin coupled to the base and arranged to extend toward the closure, the closure is formed to include a socket for each of the socket pins, and each socket is configured to receive one of the socket pins for sliding movement therein during movement of the sealing ring to engage and disengage the valve seat.

18. The fuel-transfer system of claim 17, wherein three socket pins are appended to a perimeter portion of the base and arranged to form vertices of a reference triangle receiving the base of the valve mover therein.

19. The fuel-transfer system of claim 17, wherein a first of the socket pins has an oblong cross-sectional shape and a second of the socket pins has a round cross-sectional shape.

20. The fuel-transfer system of claim 1, wherein the valve mover includes a base coupled to the closure and first and second pivot arms coupled to the base, a first pivot pin coupled to the first pivot arm and arranged to extend into a first pin receiver formed in the valve corner to intersect the pivot axis, and a second pivot pin coupled to the second pivot arm and arranged to extend into a second pin receiver formed in the valve carrier to intersect the pivot axis.

21. The fuel-transfer system of claim 20, wherein the valve mover further includes a stop member coupled to one of the first and second pivot arms and arranged to engage the valve carrier to limit pivoting movement of the valve mover about the pivot axis against the biasing spring in a direction away from the valve seat during movement of the tank inlet check valve apparatus to the opened position.

22. The fuel-transfer system of claim 20, wherein the first and second pivot arms are splayed and cooperate to form an acute included angle therebetween.

23. The fuel-transfer system of claim 20, wherein the valve carrier is formed to include a first pin guide slot terminating at the first pin receiver and a second pin guide slot terminating at the second pin receiver, each of the pin guide slots includes an inclined pin-engaging ramp and the inclined pin-engaging ramps are arranged to converge in a direction extending toward the valve seat to cause the first and second pivot arms to deform temporarily and move toward one another to guide the first pivot pin into the first pin receiver and the second pivot pin into the second pin receiver as the valve mover is moved toward the valve seat during installation of the valve mover in the valve carrier whereupon the first and second pivot arms are allowed to move away from one another owing to a resilient characteristic thereof to retain the first pivot pin in the first pin receiver and the second pivot pin in the second pin receiver.

24. The fuel-transfer system of claim 20, wherein one of the pivot arms includes a coil support, the valve mover includes an arm receiver located between the first and second pivot arms, and the biasing spring includes a coil mounted on the coil support, a housing arm coupled to the coil and biased to engage the valve carrier, and a mover arm coupled to the coil and biased to engage the arm receiver.

25. The fuel-transfer system of claim 20, wherein the valve mover further includes at least one socket pin coupled to the base and arranged to extend toward the closure, the closure is formed to include a socket for each of the socket pins, and each socket is configured to receive one of the socket pins for sliding movement therein during movement of the sealing ring to engage and disengage the valve seat.

26. The fuel-transfer system of claim 25, wherein three socket pins are appended to a perimeter portion of the base and arranged to form vertices of a reference triangle receiving the base of the valve mover therein.

27. A fuel-transfer system for a fuel system of a vehicle including a filler neck and a fuel tank, the fuel-transfer system comprising

a valve carrier formed to include a valve seat and a fuel-transfer channel and adapted to be coupled to a filler neck and a fuel tank to conduct fuel from the filler neck to the fuel tank through the fuel-transfer channel,

a diverter valve configured to mate with the valve seat and formed to include a siphon tube deflector,

a valve mover coupled to the diverter valve and pivotably coupled to the valve carrier at the pivot axis, and

a biasing spring arranged yieldably to pivot the valve mover about the pivot axis normally to move the diverter valve to mate with the valve seat to assume a closed position blocking discharge of fuel from the fuel-transfer channel through an opening formed in the valve seat and to project the siphon tube deflector into the fuel-transfer channel upon movement of the diverter valve to assume the closed position to intercept and guide a siphon tube moving through the filler neck into the fuel-transfer channel toward a bottom wall of the fuel tank.

28. The fuel-transfer system of claim 27, wherein the siphon tube deflector includes a ridge configured to provide means for engaging a siphon tube extending through the filler neck to reach the bottom wall of the fuel tank upon movement of the diverter valve to an opened position to retain the diverter valve in the opened position and an inclined surface configured to provide means for intercepting a siphon tube passing through the fuel-transfer channel and into the fuel

tank to move the valve mover against the biasing spring to cause the diverter valve to move to the opened position and place the siphon tube in engagement with the ridge.

29. The fuel-transfer system of claim 28, wherein the valve carrier includes a pipe having an interior wall defining a boundary of the fuel-transfer channel and a plurality of siphon tube guides coupled to the interior wall to lie in the fuel-transfer channel and arranged cooperatively to define means for guiding a tip of a siphon tube moving in the fuel-transfer channel in a direction toward the diverter valve to intercept in sequence the inclined surface and the ridge of the siphon tube deflector to cause the diverter valve to move to the opened position in response to continued movement of the tip of the siphon tube toward the bottom wall of the fuel tank.

30. The fuel-transfer system of claim 27, wherein the diverter valve includes a sealing ring located to engage and establish a sealed connection with the valve seat upon movement of the diverter valve to mate with the valve seat and a closure including a seal mount coupled to the sealing ring, a plate coupled to the seal mount, and a mounting post extending in a first direction away from the sealing ring through a post receiver formed in the valve member to allow rotary motion of the seal mount and seal ring relative to the valve mover in every direction within predetermined limits to enhance establishment of the sealed connection between the sealing ring and the valve seat, and the siphon tube deflector is arranged to extend in a second direction opposite to the first direction to project into the fuel-transfer channel upon movement of the sealing ring to engage the valve seat.

31. The fuel-transfer system of claim 30, wherein the plate includes an interior surface closing the opening formed in the valve seat upon movement of the sealing ring to engage the valve seat and the siphon tube deflector includes a ridge adapted to engage a siphon tube extending through the filler neck to reach the bottom wall of the fuel tank upon movement of the diverter valve to an opened position and an inclined surface arranged to extend between the ridge and the interior surface of the plate to intercept a siphon tube passing through the fuel-transfer channel and into the fuel tank to move the valve mover against the biasing spring to cause the diverter valve to move to the opened position and place the siphon tube in engagement with the ridge.

32. The fuel-transfer system of claim 27, wherein the valve carrier includes a pipe having an interior wall defining a boundary of the fuel-transport channel and a plurality of siphon tube guides coupled to the interior wall and arranged to lie in spaced-apart relation to one another and extend toward a longitudinally extending central axis of the pipe to define therebetween a reduced-diameter passageway in the fuel-transport channel sized to receive a siphon tube moving in the fuel-transport channel toward the diverter valve and guide that siphon tube to engage the siphon tube deflector.

33. The fuel-transfer system of claim 32, wherein the interior wall of the pipe has a cylindrical shape and the plurality of siphon tube guides are circumferentially spaced apart from one another about the interior wall.

34. The fuel-transfer system of claim 32, wherein each of the siphon tube guides is fin-shaped and cantilevered to the interior wall of the pipe.

35. The fuel-transfer system of claim 32, wherein each of the siphon tube guides includes a slide edge arranged to lie in substantially parallel relation to a longitudinally extending central axis of the pipe and in close proximity to the valve seat and a sloping ramp edge having a leading edge merging with the interior wall of the pipe and a trailing edge merging with the slide edge to cause the sloping ramp edges of the siphon tube guides to converge toward the longitudinally extending central axis of the pipe in a direction toward the valve seat.

36. The fuel-transfer system of claim 27, wherein the valve carrier includes a valve housing including a pipe formed to include the valve seat and the fuel-transfer channel and a sleeve surrounding a portion of the pipe formed to include the valve seat and the valve mover is pivotably coupled to the sleeve and arranged to lie outside of the fuel-transfer channel.

37. The fuel-transfer system of claim 36, wherein the valve carrier further includes a housing jacket overmolded onto the valve housing and adapted to be coupled to a filler neck and a fuel tank and the valve housing further includes a radially outwardly extending annular pipe anchor coupled to an exterior surface of the pipe and arranged to mate with the housing jacket and the sleeve includes a proximal end coupled to the radially outwardly extending annular pipe anchor.

38. The fuel-transfer system of claim 36, wherein the valve mover includes first and second pivot pins extending in opposite directions from one another to extend respectively into first and second pin receivers formed in the sleeve and the sleeve is formed to include a first pin guide slot terminating at the first pin receiver and a second pin guide slot terminating at the second pin receiver.

39. The fuel-transfer system of claim 38, wherein the valve mover further includes a first pivot arm carrying the first pivot pin and a second pivot arm carrying the second pivot pin, each of the pin guide slots includes an inclined pin-engaging ramp, and the inclined pin-engaging ramps are arranged to converge in a direction extending toward the valve seat to cause the first and second pivot arms to deform temporarily and move toward one another to guide the first pivot pin into the first pin receiver and the second pivot pin into the second pin receiver as the valve mover is moved toward the valve seat during installation of the valve mover in the valve carrier whereupon the first and second pivot arms are allowed to move away from one another owing to a resilient characteristic thereof to retain the first pivot pin in the first pin receiver and the second pivot pin in the second pin receiver.

40. The fuel-transfer system of claim 39, wherein one of the pivot arms includes a coil support, the valve mover includes an arm receiver located between the first and second pivot arms, and the biasing spring includes a coil mounted on the coil support, a housing arm coupled to the coil and biased to engage the valve carrier, and a mover arm coupled to the coil and biased to engage the arm receiver.

41. A fuel-transfer system for a fuel system of a vehicle including a filler neck and a fuel tank including a top wall and a bottom wall spaced apart from the top wall, the fuel-transfer system comprising

a valve carrier including a pipe formed to include a fuel-transfer channel and a valve seat defining an opening into the fuel-transfer channel and a sleeve located adjacent to a portion of the pipe formed to include the valve seat, the sleeve is formed to include a first pin receiver, a first pin guide slot terminating at the first pin receiver, a second pin receiver, and a second pin guide slot terminating at the second pin receiver, and

a tank inlet check valve apparatus mounted on the sleeve for pivotable movement about a pivot axis between a closed position engaging the valve seat to block discharge of fuel from the fuel-transfer channel and an opened position disengaging the valve seat to allow discharge of fuel from the fuel-transfer channel, the tank inlet check valve apparatus including first and second pivot pins extending in opposite directions from one another to extend along the pivot axis respectively into the first and second pin receivers formed in the sleeve to support the tank inlet check valve apparatus for pivotable movement about the pivot axis.

42. The fuel-transfer system of claim 41, wherein the tank inlet check valve apparatus includes a first pivot arm carrying the first pivot pin and a second pivot arm carrying the second pivot pin, each of the pin guide slots includes an inclined pin-engaging ramp, and the inclined pin-engaging ramps are arranged to converge in a direction extending toward the valve seat to cause the first and second pivot arms to deform temporarily and move toward one another to guide the first pivot pin into the first pin receiver and the second pivot pin into the second pin receiver whereupon the first and second pivot arms are allowed to move away from one another owing to a resilient characteristic thereof to retain the first pivot pin in the first pin receiver and the second pivot pin in the second pin receiver.

43. A fuel-transfer system for a fuel system of a vehicle including a filler neck and a fuel tank, the fuel-transfer system comprising

a valve carrier formed to include a valve seat and a fuel-transfer channel terminating at the valve seat and adapted to be coupled to a filler neck and a fuel tank to conduct fuel from the filler neck to the fuel tank through the fuel-transfer channel and

a tank inlet check valve apparatus mounted on the valve carrier for movement between a closed position engaging the valve seat to block discharge of fuel from the fuel-transfer channel and an opened position disengaging the valve seat to allow discharge of fuel from the fuel-transfer channel, the tank inlet check valve apparatus including a valve mover mounted for movement on the valve carrier, a biasing spring arranged normally to urge the valve mover in a direction toward the valve seat, a valve including a closure and a sealing ring coupled to the closure to move therewith relative to the valve seat, and means for coupling the closure to the

valve mover to allow rotary motion of the valve relative to the valve mover in every direction within predetermined limits so that the sealing ring is self-aligning and mates with the valve seat upon movement of the tank inlet check valve apparatus to the closed position.